INTERNATIONAL STANDARD

ISO 15695

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Vitreous and porcelain enamels — Determination of scratch resistance of enamel finishes

Émaux vitrifiés — Détermination de la résistance à la rayure des surfaces émaillées

Reference number
ISO 15695:2000(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 15695 was prepared by Technical Committee ISO/TC 107, *Metallic and other inorganic coatings*.

Vitreous and porcelain enamels — Determination of scratch resistance of enamel finishes

1 Scope

This International Standard specifies a test method for the determination of the scratch resistance of enamel finishes. The method is based on ISO 1518:1992, *Paints and varnishes — Scratch test*, but is performed at significantly higher forces.

The value of the scratch resistance that is obtained is a measure of the durability of porcelain enamel finishes when scratched by sharp objects under high forces. The value should not be confused with scratch hardness, a quantity that is measured by the procedure described in EN 101:1991, *Ceramic tiles — Determination of scratch hardness of surface according to Mohs.*

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 2723:1995, *Vitreous and porcelain enamels for sheet steel — Production of specimens for testing.*

ISO 2724:1973, *Vitreous and porcelain enamels for cast iron — Production of specimens for testing.*

ISO 7724-3:—[1)], *Paints and varnishes — Colorimetry — Part 3: Calculation of colour differences by CIELAB.*

ISO 13804:1999, *Vitreous and porcelain enamels for aluminium — Production of specimens for testing.*

3 Terms and definitions

For the purposes of this International Standard, the following term and definition apply.

3.1
scratch resistance
highest force, in newtons, at which the scratch retains the colour of the felt pen for each individual colour (red, green, blue and black) over less than 50 % of the tested length

4 Principle

By means of an apparatus with a diamond indenter, a test specimen is submitted to a stepwise insertion force. The scratches obtained are subsequently coloured using felt pens with erasable ink.

1) To be published. (Revision of ISO 7724-3:1984)

The erasability of these colourations is a measure of the resistance to scratching of the enamelled product.

The trace that may be left by the diamond after testing does not constitute a failure for the purpose of this assessment.

5 Apparatus

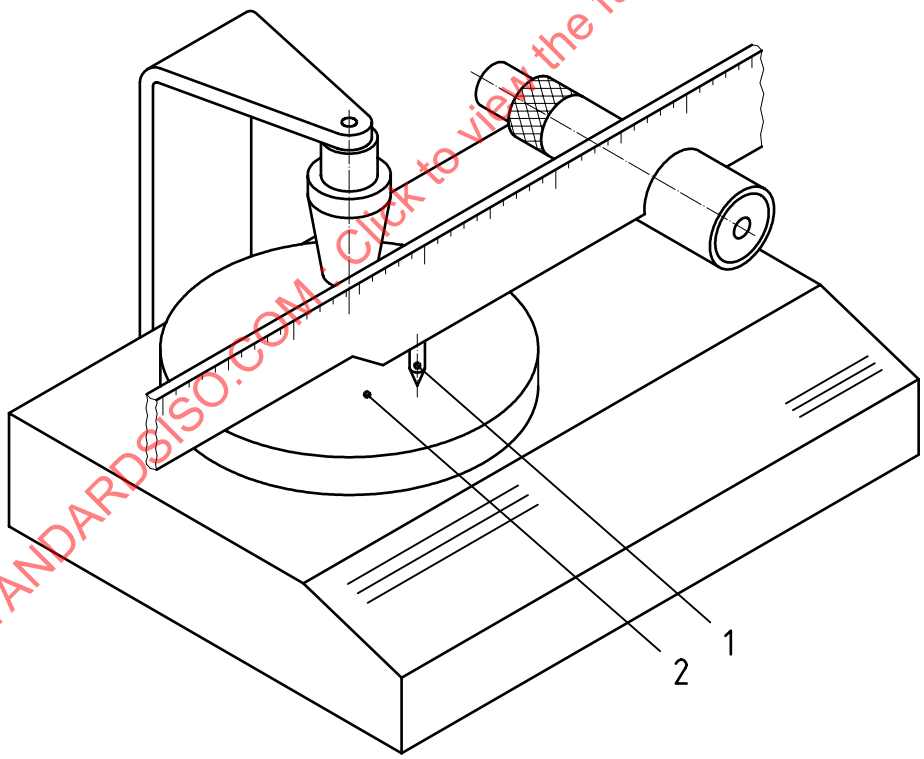
5.1 Turntable and indenter

The apparatus shown in Figure 1 consists of a turntable with a radius of at least 50 mm and a clamping device. When started, the turntable shall be able to make only one complete revolution in 10 s to 13 s, and then stop automatically.

The equipment comprises a diamond indenter with a cone angle of 90° ± 1° and a curvature of radius of 90 μm ± 3 μm held in a holder of Fe 360 (see Figure 2). The crystallographic main axis <001> of the diamond and the longitudinal axis of the holder shall be parallel to each other. The diamond indenter shall be able to provide forces from 0 N to 10 N with a precision of 0,1 N, by means of an arm with suitable weights.

5.2 Felt pens

Red, green, blue and black felt pens of identical manufacture are required. After each colour has been applied to the test specimen, allowed to dry and wiped with a cotton cloth, the surface discolouration shall be dE^* = 10 maximum, in accordance with ISO 7724-3.



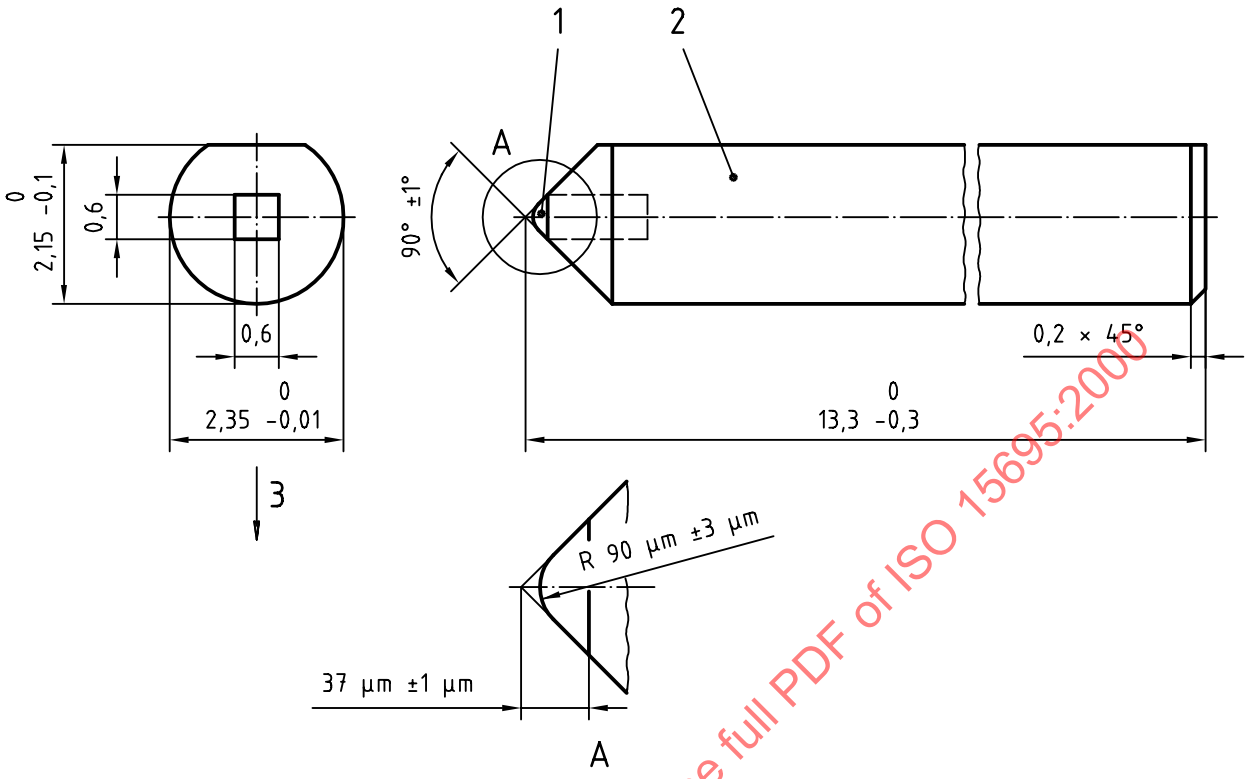
Key

1 Indenter

2 Turntable

Figure 1 — Apparatus

Dimensions in millimetres unless stated otherwise



Key

1 Diamond
2 Holder
3 Relative direction of the movement of the diamond with respect to the test specimen

Figure 2 — Indenter

6 Preparation of test specimens

Test specimens shall be prepared in accordance with ISO 2723 for steel, ISO 2724 for cast iron or ISO 13804 for aluminium. The coating thickness of the enamel shall be at least 50 µm. The test specimen shall be cleaned with alcohol and dried with a cotton cloth.

7 Procedure

The test procedure consists of the following steps.

a) Attach the test specimen to the turntable.

b) Adjust the radius of the circle so that all circles can be made between 25 mm and 45 mm.

c) Adjust the apparatus so that the diamond indenter forms a 90° angle with the test specimen.

d) Set the initial force to 10 N.

e) Create a circular scratch by turning the test specimen 360° at a force of 10 N.

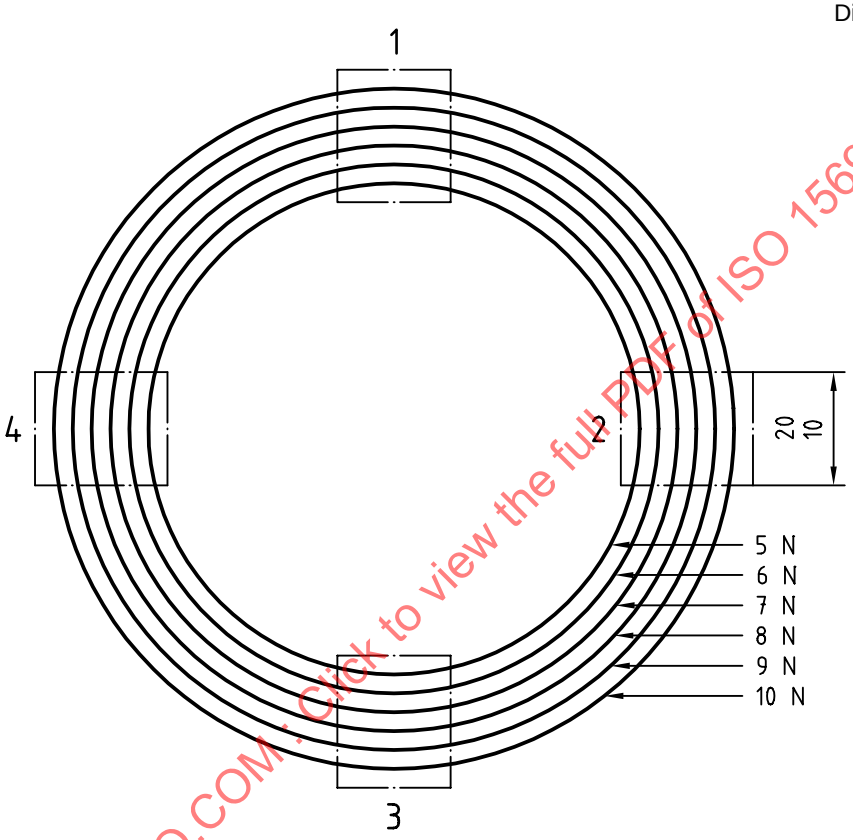
f) Adjust the force and the radius. Repeat the procedure with the next lower force using increments of 1 N. The greatest force shall always be used for the outer circle. Adjust the radius by an increment of 1 mm or 2 mm for each value of force between 0 N and 10 N (see Figure 3).

g) Colour the circles with felt pens (5.2) as shown in Figure 3.

h) Wait at least 1 min for the ink to dry.

i) Wipe each coloured area with a separate dry clean cotton cloth.

Dimensions in millimetres



Key

1 Black
2 Red
3 Blue
4 Green

Figure 3 — Example of a typical scratch and colouring pattern

8 Determination of the scratch resistance

Inspect the test specimen visually at a distance of 25 mm under typical laboratory illumination conditions (500 lux to 800 lux). Record the highest force at which the scratch retains the colour of the felt pen for less than 50 % of the tested length. This force value represents the measure of the scratch resistance of the enamel coating.

If there is any doubt about the estimated 50 % value, the determination shall be repeated by another person.